

Specification for

Nickel and nickel alloys: bar

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The preparation of this British Standard was entrusted by the Non-Ferrous Metals Standards Policy Committee (NFM/-) to Technical Committee NFM/10, upon which the following bodies were represented:

- British Non-Ferrous Metals Federation
- British Steel Industry
- Engineering Equipment and Materials Users' Association
- Ministry of Defence
- Nickel Development Institute
- Non-Ferrous Metal Stockists
- Process Plant Association
- Stainless Steel Fabricators' Association of Great Britain
- Coopted members

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Foreword

This British Standard has been prepared under the direction of the Non-ferrous Metals Standards Policy Committee. It incorporates Amendment No. 1 issued in 1984 together with further technical changes but it does not reflect a full review or revision of the standard, which will be undertaken in due course. This edition of BS 3076 replaces BS 3076:1976 which is withdrawn. It is one of a series for nickel and nickel alloys in various wrought forms intended for general engineering purposes. Others in the series are:

BS 3071, *Specification for nickel copper alloy castings.*

BS 3072, *Specification for nickel and nickel alloys: sheet and plate.*

BS 3073, *Specification for nickel and nickel alloys: strip.*

BS 3074, *Specification for nickel and nickel alloys: tube.*

BS 3075, *Specification for nickel and nickel alloys: wire.*

When the standard was revised in 1976 all the alloys included in the previous edition were retained although details for the specific requirements were revised where necessary. Two additional alloys were introduced, to which new designations were assigned. As previously, the same designations were used throughout the series for wrought nickel and nickel alloys.

In this edition provision is made for testing material to alternative proof stress criteria, and in addition, for the supply of material to comply with a minimum proof stress requirement at one or more specified elevated temperatures, when requested by the purchaser. Additional proof stress requirements at room temperature and at elevated temperatures have been introduced for alloy NA21.

It is recommended that the results of elevated temperature tests together with information on the product dimensions, the room temperature tensile properties and the chemical composition of the material should be sent to:

Secretariat of NFM/10
British Standards Institution
3 York Street
MANCHESTER M2 2AT

so that, for future revisions of this standard, minimum elevated temperature proof stress values can be derived from a continuously updated data bank.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 18, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General requirements

1 Scope

This British Standard specifies requirements for nickel and nickel alloys in the form of:

- a) hot-worked round bar over 12 mm up to and including 300 mm diameter,
- b) cold-worked round bar over 8 mm up to and including 55 mm diameter, and
- c) cold-worked square, rectangular and hexagonal bar over 6 mm up to and including 55 mm wide across flats.

NOTE Appendix A gives information on the heat treatment of alloys NA18 and NA20. Proof stress properties of cold worked and annealed and hot worked and annealed nickel alloy bars at elevated temperatures are given in Appendix B. Appendix C gives the cross-references between the alloy designations in this standard and UNS designations.

2 References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3 Definitions

For the purposes of this British Standard the following definitions apply.

3.1 bar

a solid product of round, square, rectangular or hexagonal cross section

3.2 cast

the product of a furnace melt, or of a number of melts that are mixed prior to casting

3.3 batch

bars of the same cross section from the same cast, produced in the same way and heat treated together

3.4 annealing

a heat treatment of alloys for the purpose of softening

3.5 solution treatment

the heat treatment of alloys at a suitable temperature for sufficient time to ensure adequate solution of a certain phase (or phases) followed by cooling at a suitable rate to ensure retention of the phase (or phases) in solution. The term is also associated with material in the softest condition

3.6

precipitation treatment

the heat treatment of alloys to promote precipitation in order to produce optimum creep, or stress rupture and/or tensile characteristics. It may be accompanied by a change in hardness

3.7

stress relief

the heat treatment of alloys to relieve the major portion of the internal stresses resulting from cold work

4 Information to be supplied by the purchaser

The purchaser shall state the following at the time of the enquiry and order:

- a) the number of this British Standard and the designation of the material required (as given for the relevant material in section 2);
- b) the section required (round, square, rectangular or hexagonal);
- c) dimensions, including appropriate lengths;
- d) the finish required (see section 2);
- e) the condition of the material (see section 2);
- f) whether cut lengths or random lengths are required;
- g) when required, whether 1.0 % proof stress values are to be determined in place of 0.2 % proof stress values (see clause 9);
- h) whether a test certificate is required (see clause 10);
- i) whether the purchaser desires to witness tests or inspections and, if so, which tests and/or inspections are to be witnessed (see clause 11);
- j) the nature and details of any special requirements, including the method of marking (see clause 12).
- k) whether the material to be supplied shall comply with a minimum 0.2 % or 1.0 % proof stress value at one or more specified elevated temperatures (selected from Appendix B), and if so, at which temperature(s) (see 9.5).

5 Freedom from defects

Cold-worked bars shall be clean, smooth and free from harmful defects. Hot-worked bars shall be smooth and free from harmful defects.

Surface defects occurring on hot-rolled or forged material may be removed by machining, if agreed between supplier and purchaser (see 7.1).

6 Samples for chemical analysis

The chemical composition of each cast of material shall be determined on a sample that shall be representative of the cast.

7 Dimensional tolerances

7.1 Diameter (for round bar). The diameter of hot-worked or cold-worked round bar shall not differ from the specified diameter at any point by more than the appropriate tolerance specified in Table 1 or Table 2.

The tolerance on the diameter of machined round bar shall be + 0.8 mm, – 0 mm.

If necessary localized minor surface defects shall be dressed to a depth not exceeding 3 % of the diameter of the bar.

7.2 Width across flats (for square, rectangular and hexagonal bar). The width across flats shall not differ from that specified by more than the appropriate tolerance specified in Table 3.

7.3 Length. The length shall not differ from that specified by more than the appropriate tolerance given in Table 4.

7.4 Straightness. The depth of arc (deviation from straightness) shall not exceed the appropriate tolerance specified in Table 5.

7.5 Ovality. For round bars, excluding those intended for subsequent forging, measurements of two diameters at right angles of any cross section shall not differ by more than half the total appropriate tolerance specified in Table 1 and Table 2 (see also 7.1).

8 Selection of samples for mechanical tests

8.1 Selection of samples. All bars other than those intended for forging shall be grouped into batches. One test sample shall be cut from a bar selected from each batch. When tensile tests at elevated temperatures are to be carried out, one test sample shall be cut from each batch, of sufficient length to provide a tensile test piece for each test temperature.

Before test samples are cut they shall be marked to identify them with the batch they represent. Test samples shall be taken from the material as supplied and, except for material ordered in the hot-worked condition and in certain cases for alloys NA18 and NA20, shall be tested in that condition. Test samples from hot-worked material shall be appropriately heat treated before testing. No tests are required on bar intended for further forging.

Samples for mechanical test from alloys NA18 and NA20 supplied in other than the finally heat-treated condition shall be precipitation treated or solution treated and precipitation treated, as appropriate, using the conditions recommended by the supplier, which shall be within the ranges given in Appendix A.

Table 1 — Tolerances on diameter of hot-worked round bar

Diameter		Tolerance	
Over	Up to and including	Plus	Minus
mm	mm	mm	mm
12	25	0.4	0.4
25	50	0.8	0.4
50	100	1.2	0.8
100	110	3.2	1.6
NOTE For tolerances on machined round bar of all diameters see 7.1.			

Table 2 — Tolerances on diameter of cold-worked round bar

Diameter		Alloys NA11, NA12 and NA13		Alloys NA14, NA15, NA15(H) NA16, NA17, NA18 and NA21		Alloy NA20		Alloy NA20 (heat treated and descaled)	
Over	Up to and including	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
8.0	12.5	0	0.08	0	0.08	0	0.05	0.025	0.075
12.5	25	0	0.05	0.03	0.05	0	0.08	0.025	0.105
25	50	0	0.08	0.04	0.08	0	0.10	0.025	0.125
50	55	0	0.10	0.05	0.10	0	0.10	0.025	0.125